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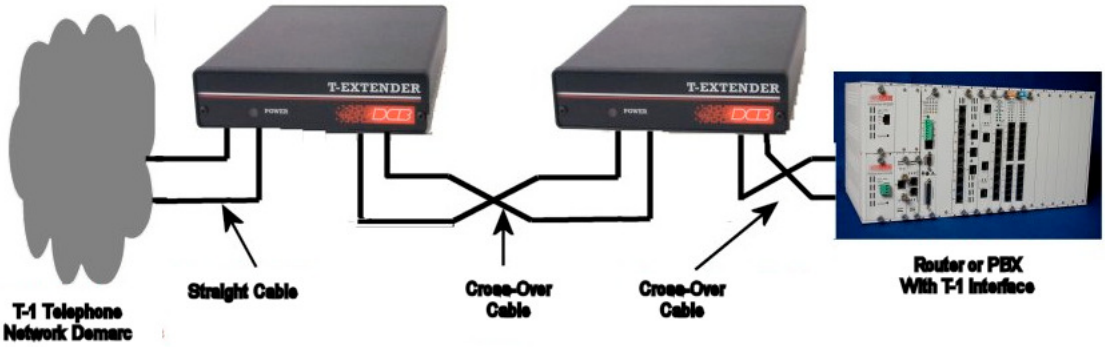
T-Extender Installation
Tricks, Tips, and Diagnosis

Overview

The DCB T-Extender is a small, no-configuration T-1 repeater used to extend T-1 lines from the standard length of 655 feet up to 4,000 to 5,000 feet or more. T-Extenders are often used in large shopping malls, high-rise buildings, military bases, and college campus environments. There are no configuration switches or settings because it is an electrical level repeater which does not modify the T-1 clocking, framing, or management bits. **The T-Extender has two identical ports**. **Either port may be used as the telco interface or the customer equipment interface.** The two ports may be used with an RJ-48 cable connector or screw-down block. Unless otherwise specified, each T-Extender is shipped with two screw block connectors and two RJ-48 adapters. The only difference is the manner of attaching the cables. Either RJ-48 or bare wire cables may be used, depending upon which connector option is plugged into the T-Extender. Additional connectors of both types are available. T-Extenders do not use span-power. They are powered by 12 VDC, 24 VDC, -48 VDC, or 120 VAC. The power supply must be specified when ordering.

Since a T-1 line is bi-directional, T-Extenders are most always used in pairs. When the length of line is greater than about 5,000 feet, additional T-Extenders must be inserted along the line each 4,000 to 5,000 feet.



Typical Application

These notes help you install and diagnose T-Extender installations using only a loopback plug and the assistance of the Telephone company service desk.

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Some Basic Facts:

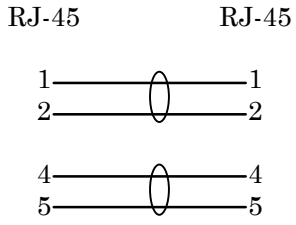
1. **T-Extender ports are identical.** Use either the one on the right or the one on the left for the cable leading to the telco. Use either the one on the right or the one on the left for the cable leading to the customer's equipment.
2. **T-Extender connections are interchangeable.** Use either the screw-down terminals or the RJ-48 connectors. Select the one that makes your installation easier for you. There is a pin out wiring diagram in the manual and at the end of this paper.
3. **T-Extenders don't use span power.** You must power them locally. Either from a local power source or from power delivered over external wires.
4. **T-Extender port pin out can be identical to customer equipment ports or the TELCO demarc depending on the RJ48 adapter used.**

   For connection to a TELCO Demarc use the adapter labeled “To TELCO Net”, P/N 9502122 (green circuit board).

   To make the crossover connection between two T/E-Extenders use adapter “To TELCO Net”, P/N 9502122 on one unit and P/N 9502172, “To Cust Equip” (blue circuit board) on the other.

   To connect to customer equipment such as a Router, DSU or PBX, use the adapter labeled “To Cust Equip”, P/N 9502172 (blue circuit board).

   In this way, all connections can be made using straight through cables.
5. **A T-1 straight-through cable.** This cable is pinned with RJ-45 pins 1,2, 4, and 5 all going straight through. That is, pin 1 on the first end is connect to pin 1 on the second end; similarly, pin 2 on each end is connected straight across the cable, and so on.



T-1 Straight Cable

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6. **T-1 Line Framing and Coding.** The T-Extender operates as an electrical repeater, raising signal levels to DS-1 or DSX-1 levels. As such, it has no bearing upon the framing or line coding. Because it is transparent to framing or coding, there is no setup or configuration required. B8ZS, ESF, SF, D4-AMI, and other framing or coding standards are all passed through the T-Extender unchanged. These are non-issues for the T-Extender, but they are important to your CPE equipment. The T-1 line and CPE equipment must be configured correctly.

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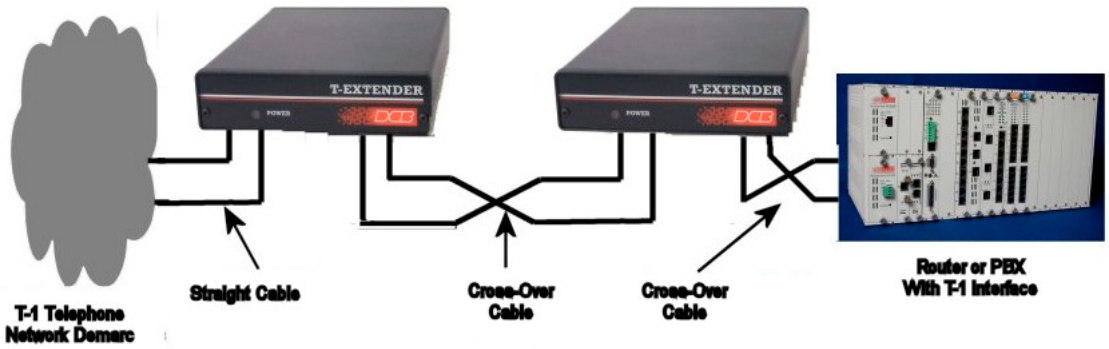
Simple Installation Example and Demonstration Setup

If this is your first T-Extender installation, or if there is some question about the installation wiring, it's advisable to temporarily install the entire network in the telco closet/room with short known-good cables and make sure it works there. From there, you can move the equipment into its final locations knowing that the equipment is operable, and works together. **It is much faster if you use the RJ-48 connection options for all T-Extenders and known good T-1 cables supplied by DCB in the optional "T-1 Installation Kit". All required cables and the loopback plug are supplied in that optional kit.**



1. Plug a straight cable between the first T-Extender and the smart jack using the "to TELCO" adapter.
2. Plug a cross cable between the first and second T-Extender. If using the RJ48 adapters, use a "to Equipment" adapter on one extender and a "to TELCO" adapter on the other with a straight through cable.
3. Connect the CPE to the second T-Extender using a straight through cable and a "to Equipment" adapter.
4. It should all work correctly, and IF the T-1 line is active from the Telco, the equipment should wake up and work correctly.
5. If it doesn't work correctly, insure that a power light is lit on all equipment and proceed to the diagnosis steps below.
6. If it works correctly, move the second T-Extender and CPE equipment to its normal location and repeat the above steps. The only variable that changes with this move should be the cabling between the two T-Extenders. If it worked up to step 5 and doesn't work after step 6, then the wiring between the two T-Extenders is suspect.

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Diagnosis

Use these steps if the above demonstration setup doesn't operate correctly. This requires the assistance of the telco. If the telco is unable to assist by testing for a hard loop on the T-1 line, then customer-owned test equipment, such as a T-berd, should be substituted for the telco demarc smartjack for testing.

1. Contact the telco repair desk and have them on-line to assist troubleshooting. First, have them verify that the T-1 install is up and configured. Tell them you have a loop back plug and will give them a hard loop as they test each section of the installation.
2. Plug a T-1 loopback plug into the Demarc. Ask the telco to verify that they "see" the loopback. If they don't, then they should correct their problem. If they do see the loopback, connect the T-Extender and move the loopback plug to the customer side of the first T-Extender, and ask again.
3. If they don't see a loop now, then either the cable to the first T-Extender is bad or the T-Extender is bad. Replace the cable with another known good cable and retest. If that still doesn't loop, replace the T-Extender with another unit. One of those replacements should indicate which is the bad equipment.
4. We have now shown that the T-1 circuit is good to the customer side of the first T-Extender. This is a good time to substitute that T-Extender with any others you have to verify that they are good. They should all loopback just as the first one did.
5. Now test the cable between the first T-Extender and the second T-Extender. Install the loopback plug on the customer side of the second T-Extender and ask if the telco sees that loop. If so, we've proven the circuit good to that point. If not, insure the correct adapters and cable are used between the two units. If the adapters are correct, substitute the cable between the two T-Extenders with a known good one. If it's still not working, substitute the second T-Extender with a known good unit and retest. If it's still not looping back to the telco, then we know that the wiring between the two T-Extenders is bad and should be tested. Replace that cable with another known good cable and retest. It should now loop correctly. Now is a good time to verify that any other cables you have are also good by substituting the cable between the T-Extenders with the other cables.
6. At this point, we know that the circuit is good to the customer side of the second T-Extender, and we've verified that the T-1 cable to be used between that port and the CPE equipment is good. If you have the ability to cause the CPE (router, PBX, etc) to loop, apply that loop to test the cross cable between the second T-Extender and the CPE equipment. If

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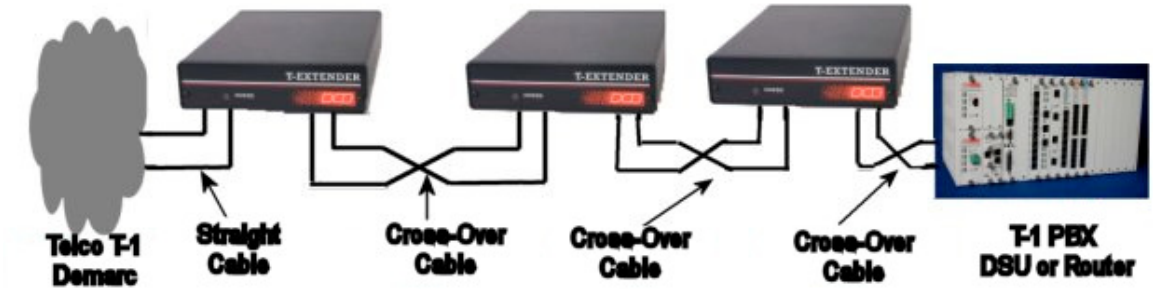
the CPE equipment doesn't have the ability to loop, insure that you are using a known good T-1 cable and the correct RJ48 adapter between it and the T-Extender.

7. We have now proven all components of the T-Extender circuit are good and that the system will loop all the way to the CPE equipment. Have the Telco make the circuit normal. If the CPE equipment doesn't come up and work correctly, the problem is likely in the CPE equipment or its configuration.

Longer Cable Runs

For cable runs longer than about 5,000 feet, multiple T-Extenders are used, with an additional T-Extender inserted in the line every 5,000 feet. Remember to use a cross-over cable between each pair of T-Extenders. Diagnose problems in these runs using the same technique as above.



Longer Run Using Three T-Extenders

A Few Words About T-1 Cable

The T-Extender works best using standard T-1 telephone cable such as 22 guage solid copper shielded twisted pair. Like most T-1 equipment, it does not always work well using Category 5 or 6 Unshielded Twisted Pair (common LAN "Cat 5 UTP" cable). We recommend the installation of only T-1 telephone cable such as Belden #7838A, Comm Scope # 21102D, General Cable # 7056880, or Madison Cable # 14035.

The T-Extender has a –36 dB dynamic range. That is, it will work well when the received signal level is between 0 dB and –36 dB. Since the transmit level is 0 dB, it will tolerate as much as 36 dB of loss between two units. Good engineering practice requires somewhat less than 36 dB of signal loss between two T-Extenders to allow for degradation of the installed cable over time.

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Cable Length limits

T-1 lines are normally terminated using the DSX or DSX-1 interface standards. This standard requires the interface to operate correctly with cable lengths up to 655 ft. Since T-1 lines are bi-directional, the T-Extender must be located within 655 cable feet of both devices it connects to (other than another T-Extender). The distance between two T-Extenders may be up to about 5,000, depending upon the cable in use.

T-Extender Connectors

Terminal Block

Signal	In/Out
Receive	IN
Receive	IN
Transmit	OUT
Transmit	OUT

RJ48 Adapter, "To TELCO Net" P/N 9502122 (Green)

Pin	Signal	In/Out
1	Receive	IN
2	Receive	IN
3	not used	
4	Transmit	OUT
5	Transmit	OUT
6	not used	
7	not used	
8	not used	

Use this adapter and a straight through cable to connect to a TELCO Demarc (Network) interface.

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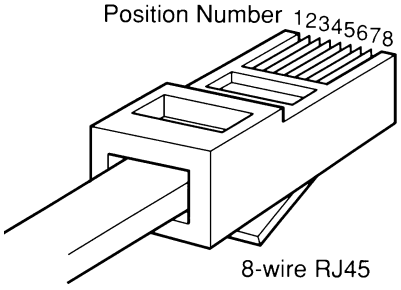
RJ48 Adapter, "To Cust Equip" P/N 9502172 (Blue)

Pin	Signal	In/Out
1	Receive	OUT
2	Receive	OUT
3	not used	
4	Transmit	IN
5	Transmit	IN
6	not used	
7	not used	
8	not used	

Use this adapter and a straight through cable to connect to an Equipment (DSU, Router, PBX, etc.) interface.

RJ-48 Cable Pin Assignments



T-Extender Terminal Block Connections